GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT INITIATION

Date: 11/03/80

Project Title: Interaction of RNA Polymerase with DNA Sites

Project No: G-41-D02 (Subproject is G-32-D02/Wartell/Biology)

Project Director: Dr. Roger M. Wartell

Sponsor: DHEW/PHS/NIH - National Institute of Allergy and Infectious Disease

Agreement Period: From 7/1/80 Until 6/30/81

Type Agreement: Grant No. 5 K04 AI00332-02

Amount: $26,805 (G-41-D02) Cost sharing: $1,850 (G-41-346)
$ 9,000 (G-32-D02)
$35,805 NIH Total (02 year)

Reports Required: Annual Progress Reports w/Continuing Applications
Terminal Progress Report upon Grant Expiration

Sponsor Contact Person (s):

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(thru OCA)

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Defense Priority Rating: N/A

Assigned to: Physics (School/[illegible])

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Project Code (OCA)

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 2/14/84

Project No. G-41-D02 School/~~Lab~~XXX Physics

Includes Subproject No.(s) G-32-D02/Wartell/Biology

Project Director(s) Dr. R. M. Wartell ~~GTRI~~XXXX / GIT

Sponsor DHEW/PHS/NIH - National Institute of Allergy and Infectious Disease

Title Interaction of RNA Polymerase with DNA Sites

Effective Completion Date: 6/30/81 (Performance) 6/30/81 (Reports)

Grant/Contract Closeout Actions Remaining:

- [X] None
- [ ] Final Invoice or Final Fiscal Report
- [ ] Closing Documents
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other

Continues Project No. Continued by Project No. G-41-D03
and Sub. G-32-D03

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Other

PROGRESS REPORT	GRANT NUMBER 5K04 A01 00332-03	
NAME OF HEAD OF DEPARTMENT OR DEPARTMENTAL SUBDIVISION Charles Braden	ACCOMPLISHMENTS COVERING PERIOD FROM 7/1/80	THROUGH 6/30/81
NAME OF AWARDEE Roger M. Wartell		
INSTITUTION Georgia Institute of Technology		
TITLE OF RESEARCH PROPOSAL (REPEAT TITLE SHOWN ON PAGE 1) Interaction of RNA Polymerase with DNA Sites		

STATEMENT OF ACCOMPLISHMENT (IF SPACE IS INADEQUATE, USE CONTINUATION PAGE)

Research

Progress has been made over the past year on characterizing the conformational properties of DNA restriction fragments containing promoter sites. This is the 50-70 base pair site where RNA polymerase specifically binds to initiate transcription. Two types of studies have been carried out. The temperature induced transition of duplex DNA fragments to single strands was studied. This work is aimed at characterizing the thermal stability of different parts of the promoter region. A second set of studies employed Raman spectroscopy to determine the conformation of DNA restriction fragments under various solvent conditions.

Absorption spectroscopy was used to measure the helix-coil transition of eight short DNA restriction fragments 80-301 bp. in length. These DNAs form different parts of the E. coli lactose operon transcription initiation region. Since the base pair sequences of these DNAs were known, a comparison of the experimental transitions with theoretical models of the transitions was possible. An accurate theoretical model was developed which predicted the experimental curves in solvents of 0.1 m NaCl or higher (1,2). Theoretical analysis shows that a thermal stability boundary exists about 50 base pairs behind the transcription start point. The theoretical model is being applied to the question of base pair opening under physiological conditions (3)

Raman spectroscopy has been used to examine the vibrational spectra of purified DNA restriction fragments. X-ray structures of the DNAs have been previously correlated with characteristic vibrational frequencies and intensity ratios in the Raman spectra. Studies have been made on 95 bp. and 144 bp. DNA fragments containing the lactose operon promoter site. In 0.01 Na^+, 0.1 m Na^+ and 4. m Na^+ solvents, these DNAs are observed to maintain the 'B' type conformation. A collaborative study was carried out with R. D. Wells and associates (Univ. of Wisconsin, Madison, Wisc.) on a 157 bp. DNA containing $(dG\text{-}dC)_n$ $(dG\text{-}dC)_n$ sequences at both ends of the 95 bp. lac fragment. Raman spectra of this molecule provides conclusive evidence for a junction between left handed and right handed duplex helices in 4.0 M NaCl solutions. Analysis of this Raman data is underway (4). Recent work has focused on developing methods to quantify the peak heights and widths of overlapping Raman bands. This information will provide added information on the Raman spectra of complex molecules such as DNA.

Publications

1. "Theory Agrees with Experimental Thermal Denaturation of Short DNA Restriction Fragments" by A. S. Benight, R. M. Wartell and D. K. Howell, Nature 289, 203-205, 1981.
2. "High Resolution Experimental and Theoretical Thermal Denaturation Studies on Restriction Fragments Containing the E. coli Lactose Control Region" by W. Hillen, T. Goodman, A. S. Benight, R. M. Wartell and R. D. Wells, J. Biol. Chem., in press.

(continued)

Publications (continued)

3. "Fluctuation Base Pair Opening in DNA at Temperatures Below the Transition Region" by R. M. Wartell and A. S. Benight, submitted for publication.
4. "The Junction Between 'Z' and 'B' Conformations in a DNA Restriction Fragment: Evaluation by Raman Spectroscopy" R. M. Wartell, J. Klysik, W. Hillen, and R. D. Wells, in preparation.

Professor Wartell has taught our undergraduate biophysics laboratory course, Phys. 4253, which is an essential component of our option in biophysics. Plans have been completed to increase the credit for this laboratory and, in collaboration with the School of Chemistry, render the course suitable for both chemistry and physics majors. He has also supervised several students who have elected to include "special problems" work in the area of biophysics in their degree programs.

Three graduate students are well into their doctoral thesis work under the supervision of Professor Wartell.

Professor Wartell serves on three active and important departmental committees: (a) the elected Faculty Advisory Committee of the School of Physics, which advises on all aspects of the operation of the School, (b) the Graduate Committee of the School of Physics, which handles most aspects of the graduate program in physics, and (c) the Life Science Committee (of which he is chairman), which coordinates and advises on academic matters related to the life sciences throughout the College of Sciences and Liberal Studies (including the Schools of Biology, Chemistry, and Physics).

Professor Wartell presented invited lectures at the Jena International Biophysical Symposium (September 1980) and at the Physics Department of Purdue University (October 1980).

Professor Wartell's academic activities, viz. scholarly contributions, supervision of doctoral theses, and teaching of key biophysics courses, comprise the most important component of the School of Physics effort in the area of biophysics.